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Groundwater Management Strategy for Michigan
Task 4: Resource Definition

Michigan Dept. of Natural Resources, Lansing

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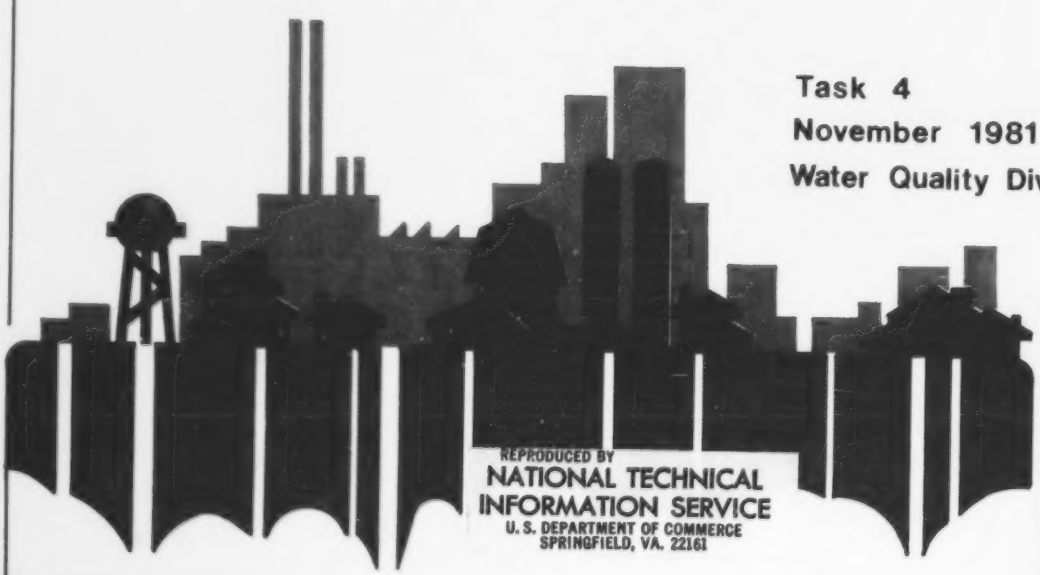
Resource Definition



Task 4
November 1981
Water Quality Division

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This document determines to what extent Michigan's groundwater resources have been defined, by describing the types, location and quantity of groundwater information in table form. The tables also list descriptions of the type of data, legal authorities for data collection, collecting party, geographic coverage, updating frequency and if a computerized data base exists. Appendices include addresses where information can be obtained or reviewed and maps denoting county coverage of certain information. The document also discusses ongoing groundwater resources definition programs and additional groundwater resource definition needs.

17. Document Analysis a. Descriptors

Groundwater
Groundwater Management
Groundwater Pollution
Resource Management
Water Quality
Water Pollution
Water Quality Management

b. Identifiers/Open-Ended Terms

Information Inventory
Information Location
Information Sources
Qualitative Information
Quantitative Information

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RESOURCE DEFINITION

Groundwater Management Strategy
for Michigan
Task 4: Resource Definition

November, 1981
Water Quality Division
Michigan Department of
Natural Resources

Groundwater Management Strategy for Michigan

TASK 4: RESOURCE DEFINITION

Goal: To determine to what extent the State's groundwater resources have been defined.

Objectives:

1. To determine the types and location of groundwater-resource information.
2. To determine the amount of information available in defining Michigan's groundwater resources.
3. To identify additional informational needs.

Output: A tabulation of available groundwater resource information, and a brief discussion of additional needs to adequately define Michigan's groundwater resources.

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A. INTRODUCTION

Scope of Task: This task primarily represents an effort to identify and locate available information on Michigan's groundwater resources, and compile it for use by agencies, institutions and firms involved in groundwater management. Secondarily, it discusses the types and amount of additional information needed to adequately define the State's groundwater resources, that is, to have adequate data and information in a useable format, to allow for management decisions regarding groundwater use and protection.

The informational portion of this task includes:

a. Tables and appendicised listings of 1) qualitative and quantitative groundwater information obtained regularly, intermittently, or through special studies, by regulatory agencies, and by non-regulatory agencies, institutions and firms engaged in groundwater investigations; and 2) major compilations and bibliographies of publications on groundwater resource assessment and management;

b. Descriptions of ongoing groundwater-related programs which will, or may, add to the existing qualitative and quantitative information bases; and

c. A discussion of identified inadequacies, corrective measures and additional information needed to adequately define the State's groundwater resources.

It is beyond the scope of this task to:

a. Evaluate the quality, adequacy or appropriateness of specific groundwater information compiled for this report;

b. Generate new groundwater information;

c. Present information not directly pertaining to groundwater quantity or quality, but which may be used in groundwater investigations; i.e. topographic maps, lake surveys, climatological data, etc.;

d. Perform an in-depth search for individual publications and maps pertaining to groundwater (see note below);

e. Present information generated by private firms, subject to confidentiality or propriety constraints; and

f. Include every location of groundwater information. Primarily only those locations with complete or extensive sets of information were included.

Note: A two volume comprehensive bibliography titled "Hydrogeology for Underground Injection Control-Text" (Table 3) and "Hydrogeologic

Atlas of Michigan" (Table 2) of published and unpublished books, pamphlets, articles, etc. on Michigan's geological resources is currently being prepared by Western Michigan University through a U.S. EPA-funded Underground Injection Control Project.

Sources of Information: The information in this task was compiled by staff of the Water Quality Division of the Michigan Department of Natural Resources. Questionnaires, letters, telephone communications and personal interviews were utilized to gather information from individuals and organizations engaged in, or associated with, the collection, assessment and dissemination of groundwater information, and/or the management of groundwater resources in general.

The following types of information were obtained through distribution of questionnaires or other communications:

a. Types of available groundwater-related information.

b. Location of available information and public accessibility.

c. Quantity of data as well as frequency of data acquisition.

d. Format of data, and availability of computerized data bases.

e. Availability of groundwater computer programs.

The information obtained from all sources has been compiled, organized and listed in tables as presented in Part B and discussed in Part C of this report.

B. AVAILABILITY AND LOCATION OF INFORMATION

Discussion: The information gathered through research, questionnaires, and other communications has been organized and presented in three tables. Table 1 lists the types and sources of information that characterize the qualitative aspects of groundwater in Michigan. It consists mainly of water well sampling information. Table 2 presents information useful in determining the location, quantity, and physical character of groundwater. This information consists mainly of well records, surveys and maps. Table 3 consists of documents generally containing both qualitative and quantitative information and/or management aspects of groundwater. Pertinent miscellaneous information is also included.

The information compiled in each of the tables is categorized by:

type of information
location where available
collecting agency/purpose/legal authority
short description
quantity of data
geographic coverage
updating frequency
availability of computer data bases

Descriptions of these categories follow:

Type of Information: The type of qualitative or quantitative data is identified in this category. In the case of studies, reports or maps which assist in the management of groundwater resources, a short title may be provided.

Available From: This category identifies the location where the information is available. While information may be collected or prepared by one agency, it may be available through a multitude of sources. A list of abbreviated names of sources is provided on the page preceeding the tables. (See Appendix 1 for addresses and phone numbers.) No effort was made to include all locations, only those with the most complete sets of records. There may be a charge for copying information and some information must be viewed at the agency.

Collecting Agency/Purpose/Legal Authority: Indicated here is the agency or institution responsible for collecting or preparing the information, as well as the purpose for obtaining such information. Where the information is prepared in response to statutory mandates or administrative requirements, the applicable law or rule is identified.

Description: A brief description and/or components only of the information pertaining to groundwater of the particular document is presented in this category.

Quantity: An approximation of the volume of existing information (through 1980) and, if available, the rate of accumulation of additional information, is provided here.

Geographic Coverage: While some information has been prepared at some point in time for a specific area, most of the regularly collected data cover the entire state. The extent of geographic coverage varies mostly with the concentration of water supply wells and locations of discharges to the groundwaters. The geographic coverage of certain types of information is presented graphically in appendices as identified on the tables.

Updating frequency: This category identifies whether the information was prepared in response to specific need, or whether it is updated or added to on a regular basis. If updated or added to on a regular basis, the word "continuously" appears on the Tables.

Computerized data bases: Indicated here is the availability of data in a computerized form, possibly accessed through various interactive systems. A compilation of computerized groundwater data bases and groundwater related programs is presented in Appendix II.

TABLES

1. Qualitative Information

2. Quantitative Information

3. Qualitative and Quantitative Documents and Miscellaneous Information

ABBREVIATIONS

ASD = Administrative Services Division (Data Center)
C/DHD = County/District Health Departments
CEHD = Community Environmental Health Division
EED = Environmental Enforcement Division
ESD = Environmental Services Division
GSD = Geological Survey Division
M.D. = Microbiology Division
MDNR = Michigan Department of Natural Resources
MDOT = Michigan Department of Transportation
MDPH = Michigan Department of Public Health
MSU = Michigan State University
RHD = Radiological Health Division
RRD = Resource Recovery Division
SCS = Soil Conservation Service
TRD = Testing & Research Division
USDA = U.S. Department of Agriculture
USEPA = U.S. Environmental Protection Agency
USGS = U.S. Geological Survey
WMD = Water Management Division
WMU = Western Michigan University
WQD = Water Quality Division
WRD = Water Resources Division (USGS)
WSD = Water Supply Division

TABLE 1 - Qualitative Information

Type of Information	Available From:	Purpose/Legal Authority/ Collecting Party	Description	Quantity	Geographic Coverage	Updating Frequency	Computerized Data Bases
Chemical	MDPH - WSD MDPH - CEHD	Testing of Type I community water supplies; under Act 399 (1976). By MDPH	Routine and non-routine analyses: Complete (organic, inorganic, trihalomethane) or Partial (basic inorganic).	3600 partial 790 complete (for 1980)	Statewide	Continuous (data on file only for 2 years)	Being Developed
	MDPH - WSD MDPH - CEHD C/DHD	Testing of Type II public water supplies by C/DHD, under Act 399 (1976)					
	C/DHD MDPH - CEHD	Testing of private water and Type III public supplies by C/DHD; for specific reason or as public service; under Act 368 (1978) & Act 399 (1976).	Routine and non-routine analyses: Partial (basic inorganic)	72,100 (for 1980)	Statewide	Continuous; upon need	Being Developed
	MDNR - ESD	Assessment of selected chemicals in the groundwater. By MDNR - ESD (Office of Toxic Materials Control)	Chemical evaluations of toxic, physical and chemical properties of selected parameters.	over 2000	Site Specific; statewide	Sporadic	No
	MDNR - WMD MDNR - ASD	Testing by MDNR - WMD associated with: 1. g.w.[1] discharge permits under Act 245 (1929) 2. special g.w.[1] studies	Routine and non-routine analysis by Department staff and/or private firms. Types of analyses depend on specific needs (inorganic and organic).	≃ 17,000 samples in 1980 (each sample may require several analyses)	Statewide	Continuous	1. Yes[2] 2. No
	MDNR - RRD MDNR - ASD	Testing by MDNR - RRD associated with: 1. permit requirements under Act 641 (1980) 2. special studies		1000's of samples each year	Statewide	Continuous	Yes[2]
	MDNR - GSD	Testing by MDNR - GSD associated with special studies	Types of analyses depend on specific needs.	100's of samples	Site Specific	Sporadic	No
	MDNR - WQD	"Potential Severity Rating"; of g.w.[1] contamination sites. By MDNR - WQD	Evaluates potential severity of groundwater degradation at known contamination sites.	≃ 400 sites (thru 8/81)	Statewide	Continuous (dependent on funding)	Yes
	MDOT - TRD	Testing of selected highway facilities as need arises; by MDOT - TRD.	Types of analyses depend on specific needs.		Site Specific; statewide	Sporadic	No
	USGS - WRD	Data collecting cooperative program between USGS & MDNR; for annual G.W.[1] Data for Michigan (USGS).	Routine analyses of permanent observation & other wells (Fe, T.S., Hardness, Pesticides, etc.) 84 parameters per well.	(1975-1980) 142 wells	Most of 83 Counties	Some continuous, some sporadic	Yes
	USGS - WRD	Testing by USGS associated with special studies[3].	Types of analyses depend on specific project requirements.		Site Specific	Sporadic	Yes
	National Water Well Assoc. (NWWA)	"Groundwater Quality Atlas of the United States"; (1979) by NWWA for generalized quality information.	State maps designating generalized Water Quality	3 Michigan maps, 6 quality parameters	Statewide		
Bacteriological	MDPH - WSD MDPH - MD MDPH - CEHD	Testing of Types 1 & 2 public water supplies; under Act 399 (1976). By MDPH - MD.	Routine testing for total coliform content	≃ 70,000/year	Statewide	Continuous	Being Developed
	C/CDHD	Testing of private & Type III public water supplies	Testing for total coliform	≃ 60,000/year	Statewide	None	Being Developed
Radiological	MDPH - RHD MDPH - WSD	Testing of community water supplies & nuclear facilities by MDPH-RHD under Safe Drinking Water Act(U.S. Public Law 93-523)	Routine testing of natural and man-generated radioactivity.	≃ 11,000/year (since 1978)	Statewide	Every 4 years	Being Developed

[1] g.w. = groundwater

[2] Computerized information retained at MDNR - ASD

[3] Reports of studies referenced in Michigan Groundwater References, 1980 MDNR or Water Resources Activities in Michigan. See Table 3 References - Bibliographies

TABLE 2 - Quantitative Information

	Type of Information	Available From:	Purpose/Legal Authority/ Collecting Party	Description	Quantity	Geographic Coverage	Updating Frequency	Computerized Data Bases
RECORDS	Water Well Records	MDNR - GSD; C/CHD	Mandatory submittal[1] by drillers of all water well records to GSD & C/DHD. Under Public Code, Act 368 (1978), formerly Act 294 (1965).	Record of well location, construction, depth, lithology, s.w.l.[2], casing, etc.	248,000 1965-1980 8,000 pre 1965	Statewide	Continuous; 1300/month	No (partial coding by USGS & WMU)
	Observation/ Monitoring Well Records	MDNR - GSD; (mostly confidential)	Mandatory submittal by private or agency drillers of observation/monitoring wells, to MDNR. Under Mineral Wells Act, Act 315 (1969).	Record of well location, construction, depth, lithology, s.w.l.[2], casing, etc.	≃1200	Statewide	Continuous; 100/month	No
	Dewatering Well Records	MDNR - GSD	Mandatory submittal for dewatering projects, involving wells >2" in diameter and >25' in depth; to GSD & C/DHD. Under Act 368 (1978) formerly Act 294 (1965).	Record of well location, construction, depths (s.w.l.[2] and dewatered level), pumping rate, discharge point, abandonment procedures. At times, more than one well per record.	≃170 (1978-1980)	Statewide	Continuous	No
	Observation Well Records	MDNR - GSD USGS - WRD	Records of observation wells for "Groundwater Data for Michigan"; by USGS.	Record of well location, depth, aquifer characteristics, s.w.l.[2] of pumpage records.	133	49 counties	Continuous periodic through year	Yes
	Irrigation Well Records	MDNR - WMD	Compilation of data on water usage for irrigation, associated with "National Water Use Inventory".	Information on water quantity pumped, and acreage irrigated. Published in "Irrigation in Michigan, 1977".	based on 850 irrigators	Statewide	For 1977 only.	No
	Oil & Gas Well Records	MDNR - GSD	Manadtory submittal by drillers of oil & gas wells, to MDNR. Under Oil & Gas Act, Act 61 (1939)	Well location & lithology	≃40,000	Statewide	Continuous	No
BORINGS, SURVEYS & TESTS	Soil Borings	MDOT - TRD	Records of soil borings associated with highway construction, and rest area water supplies, by MDOT.	Record of boring location, depth, lithology and s.w.l.[2]	1000's	Along interstate & state highways	Continuous	No
		MDNR - GSD MDOT - TRD (mostly confidential)	Submittal to MDNR under Act 315 (1969)	Boring location, depth to water	100's	Statewide	Continuous	No
		MDOT - TRD	Prepared by MDOT for all new roadway alignments.	Pedological classification of parent material & top soil; scale 1"=100'	All right of ways for past 30-40 yrs.	Statewide	Continuous	No
	Soil Surveys	USDA - SCS and Coop. Ext. Service	Prepared by USDA Soil Conservation Service, as a public service.	Post-1960 surveys indicate seasonal high water table and soil water-related characteristics (scale-4"=1 mi.)	See Appendix III		Pre-1960's surveys being updated & resurveyed to meet new format.	No
		MDNR - GSD	Prepared by USDA-SCS & DNR as a public service includes land economic surveys, reports & maps.	Pre-1960 surveys may indicate soil moisture conditions (scale-variable, many 1"=1 mi.		All Counties	None	No
	Geophysical Surveys	MDOT - TRD MDNR - GSD MDNR - RRD	Records of groundwater investigations by state agencies.	Electrical resistivity and seismic surveys.	100's	Statewide	Continuous	No
	Permeability Tests	MDOT - TRD	Records of tests performed by MDOT's TRD Lab at request of state agencies.	Sieve analyses and pump tests.	100's	Statewide	Continuous	No

Table 2 Continued

	Type of Information	Available From:	Purpose/Legal Authority/ Collecting Party	Description	Quantity	Geographic Coverage	Updating Frequency	Computerized Data Bases
MAPS [3]	"Hydrogeologic Atlas of Michigan"	WMU	Prepared by WMU (Geology Dept.) for U.S.EPA funded Underground Water Source Protection Program (completion date 1-82)	Selected maps pertaining to hydrogeology in Michigan (e.g. location of injection wells, water quality, bedrock and glacial stratigraphy)	30 plates	Statewide		No
	Groundwater Quality Atlas	National Water Well Assoc. (NWWA)	"A Groundwater Quality Atlas of the United States"; (1979) by NWWA for generalized quality information.	See Table 1 under Chemical - NWWA				
	Groundwater Availability Maps	MDNR - GSD USGS - WRD	Two maps prepared by USGS as special project output.	1. Availability of groundwater in glacial deposits. 2. Availability and quality of groundwater in bedrock.	2	Statewide Maps		No
	"A Summary of Domestic Water Supply Sources in Michigan"	MDNR - WQD	An MDNR - WQD staff report on usage of groundwater supplies.	Maps & tables displaying water usage in Michigan counties by number of people and % of population		Statewide	None	No
	Water Table Maps	MDNR - GSD	Unpublished maps prepared by MDNR's GSD for USGS cooperative agreement (done in 1930's thru 1970's)	County maps of static water level and/or piezometric surface (scale 1"=1 mile).	15	See Appendix IV		No
	Computerized Geological/Aquifer Maps	MSU-Geology MDNR - GSD	Prepared by Michigan State University for Tri-County Regional Planning Commission, GSD & WQD.	Series of computer-generated county maps; includes Depth to Water Table & colored glacial map. (scale 1:100,000)	5 counties	Allegan, Clinton, Eaton, Ingham, Kalamazoo		Yes
	Exempted Aquifer Maps	MDNR - WQD WMU - Geology	Prepared by Western Michigan University (Geology Dept.) under Underground Water Source Protection Program. (completion date Jan. 1982)	Maps of aquifers with no potential for serving as drinking water source. (scale = 1:500,000)		Statewide		Yes
	Aquifer Maps			Maps of glacial drift aquifer location & performance. (scale 1:500,000)				
	County Aquifer Vulnerability Maps (Health Dept. Aquifer Mapping Program)	MDPH - CEHO C/RHD	Cooperative effort between C/RHD's and MDPH-RHD. As indicator of aquifer conditions, for use by county sanitarians.	See Table 3 under Mapping				No
	Bedrock Availability Maps	MDNR - GSD	Unpublished maps prepared by MDNR's GSD for in-house use (done in 1930's thru 1970's)	Generally county maps of bedrock elevation and/or type of bedrock (scale: many 1"=1 mi.)		See Appendix V		No
	Drift Thickness Maps	MDNR - GSD	Unpublished maps prepared by MDNR's GSD for in-house use (done in 1950's thru 1970's)	County maps showing drift thickness (scale:many 1"=1 mi)		See Appendix VI		No
	Glacial Geology Maps (surface geology maps).	MDNR - GSD	Unpublished maps prepared by MDNR's GSD for in-house use. (done in 1900's thru 1950's)	County, 15 minute quadrangle maps showing glacial features i.e. moraines, outwash, etc. (scale=variable)		6 counties not included:Ontonagon, Keeweenaw, Mackinac, Marquette, Montcalm & Jackson		No

[1] Submittal not mandatory prior to 1965; 80% compliance since 1965.

[2] s.w.l. = Static Water Level

[3] A complete listing of maps that pertain to groundwater in Michigan is found in "Hydrogeology for Underground Injection Control-Text" See Table 3 under Publications-Bibliographies.

TABLE 3 - Quality & Quantity Documents and Miscellaneous Information

	Type of Information	Available From:	Purpose/Legal Authority/ Collecting Party	Description	Quantity	Geographic Coverage	Updating Frequency	Computerized Data Bases
CORRESPONDENCE	Groundwater Project Correspondence Files	MDNR - WQD MDNR - ESD MDNR - EED MDNR - GSD MDNR - RRD MDNR - WMD MDPH - WSD	Project files maintained & updated by agency staff. Available for public inspection under Freedom of Information Act, P.A. 442 (1976).	Files contain State, Federal & non-agency correspondence, reports, data, misc. documents pertaining to groundwater, mainly specific areas of a few sections of a township.	Thousands of pieces of information	Statewide	Continuous	No
SELECTED PUBLICATIONS	USGS - WRD "Chemical & Physical Characteristics of Natural Groundwaters in Michigan: A Preliminary Report" 1980	USGS - WRD	To assess baseline chemical data under USGS; MDNR-GSD cooperative program by USGS	Tables, maps & discussion of available quality data		Statewide		Yes
	"Great Lakes Basin Framework Study; Geology & Groundwater" (1975)	Great Lakes Basin Commission (G.L.B.C.)	A U.S.G.S. sponsored study by G.L.B.C., under Water Resources Planning Act, P.L. 89-80 (1965). Comprehensive coordinated plan for development of water & related land resources in the Great Lakes Basin.	Michigan groundwater resources are directly or indirectly discussed in Appendices: 3. Geology & Groundwater 6. Water Supply 7. Water Quality 15. Irrigation	A report with 23 Appendices & an Environmental Impact Statement	Great Lakes Basin Study	None	No
	"Michigan Surface Impoundment Assessment "	MDNR - WQD MDPH - WSD	Cooperative effort between MDNR and MDPH (1980), to determine impacts of surface water impoundments on groundwater supplies. U.S. EPA - funded study under Safe Drinking Water Act of 1974 (P.L. 93-523).	Compilation of data on number, location, construction and geologic setting of liquid waste impoundments, and assessment of groundwater contamination potential. Includes aquifer vulnerability map.	3640 sites	Statewide		Yes (U.S. EPA)
	Groundwater Assessments	MDNR - WQD	"Assessment of Groundwater Contamination in Michigan"; 1979. By MDNR - WQD	Indicates location & groundwater polluting substances at known & suspected sites.	≈650 sites	Statewide		No
		MDNR - WQD	"Assessment of Groundwater Contamination in Michigan"; 1981. By MDNR - WQD.	Indicates location & groundwater polluting substances at known & suspected sites.	≈850 sites	Statewide		Yes
	"Status Summary Groundwater Contamination in Region 14" (other regions in progress)	West Mich. Shoreline Regional Development Commission (WMSRDC)	Part of The Development of a Groundwater Quality/Toxic Contamination Assessment Strategy; U.S. EPA - funded study. By WMSRDC staff, 1980.	Status report on occurrence of chemical substances in known, suspected & potential contamination sites.	606 sites	Muskegon, Oceana, Ottawa, counties	None	No
REFERENCES (of Publications, Maps, etc.)	Bibliographies	Western Michigan University	"Hydrogeology for Underground Injection Control-Text" Prepared by WMU (Geology Dept.) for U.S. EPA, funded under "Underground Injection Control" project (completion date 1/82).	Comprehensive bibliography of published & unpublished books, reports, articles, etc. Intended to be more comprehensive than below listed bibliographies.				

Table 3 Continued

	Type of Information	Available From:	Purpose/Legal Authority/ Collecting Party	Description	Quantity	Geographic Coverage	Updating Frequency	Computerized Data Bases
	The following bibliographies, though listed in "Hydrogeology for Underground Injection Control-Text", are listed below as specific references:							
		MDNR - GSD	"Michigan Groundwater References, 1980" by MDNR - GSD	Partial listing of State & USGS publications pertaining to groundwater in Michigan (not complete)		Statewide	Biennially	No
			"MDNR Geological Survey Division Publications, 1980" by MDNR - GSD	Partial list of reports, bulletins, pamphlets, etc. Some directly/indirectly pertaining to groundwater.		Statewide	Biennially	No
			"Annotated List of the Publications of the Michigan Geological Survey 1838-1977" by MDNR - GSD	GSD publications indexed by Author, Mineral & County		Statewide		No
		USGS - WRD	"Published Reports, 1980"; in: Water Resources Activities in Michigan, by USGS-WRD	Listing of published reports on groundwater investigations in Michigan performed by USGS.		Statewide		
REFERENCE SERVICES	Reference Services & Data Retrieval Systems	USGS - WRD	"National Water Data Exchange' (NAWDEX). A USGS coordinated cooperative system for storage & retrieval of water data. Accessed by major water-data atencies. In Michigan, available through USGS.	Available Systems: 1. Environmental Data & Information Service 2. Great Lakes Regional Information Referral Center 3. National Water Data Storage & Retrieval System 4. Office of Water Data Coordination 5. Water Resources Scientific Infomation Center		Statewide	Continuous	Yes
MAPPING	County Aquifer Vulnerability Maps (Health Dept. Aquifer Mapping Program	MDPH - CEHD	Cooperative effort between C/RHD's & MDPH - RHD. As indicator of aquifer conditions for use by county sanitarians.	Map indicates areas of known groundwater quality problems, & activities with potential for groundwater contamination, & soil/bedrock limiting conditions. Scale 1"-1 mile.	8 counties completed 17 counties in progress	Appendix VII	Completion of other counties dependent upon funding	No
	Demonstration Effort for Groundwater Management	MSU - Geology MDNR - WQD	Prepared by MSU for MDNR-WQD for USEPA funded "Groundwater Management Strategy for Michigan" Section 208 or Clean Water Act P.L. 95-217	Series of computer generated maps including discussion of their uses in groundwater management	1	Kalamazoo	Dependent on funding	Yes
COMPUTER MODELS	Computer Models	See Appendix II	Computer programs developed/utilized by agencies, firms, institutions, for private or public use.	Various programs for modeling groundwater characteristics, and/or manipulating & displaying data.	≈25		Continuous	Yes

C. ONGOING GROUNDWATER RESOURCE DEFINITION PROGRAMS

Tables 1, 2 and 3 indicate a continuous updating frequency for certain ongoing groundwater related programs which will, or may, add to the existing qualitative and quantitative information bases. Many of these programs are presently underway through academic institutions and agencies, either through specially funded projects or as part of normal regulatory functions. The duration of such programs normally depends on funding availability and the term of the statutory mandate. The main programs are listed and described below:

1. Continuous state-wide gathering of physical, chemical, and bacteriological data by state regulatory agencies (DNR and DPH) for compliance and enforcement purposes under certain public acts and administrative rules (see Tables 1 & 2).

2. Continuous state-wide gathering of physical and chemical data by the U.S. Department of Agriculture and the U.S. Geological Survey, Water Resources Division, under its public service and cooperative programs (see Tables 1 & 2).

3. "Groundwater Management Strategy for Michigan" by the Michigan Department of Natural Resources. This is a comprehensive approach to the management of groundwater resources of the state, with emphasis on groundwater contamination prevention and reduction of adverse impacts of existing contamination cases. This program is funded by the U.S. EPA as part of the Clean Water Act (Section 208, Water Quality Management Planning Program). The portions of the program which specifically address groundwater data gathering and updating activities are:

   Task 2 - Prioritization of approximately 850 identified, known and suspected groundwater contamination sites, utilizing a ranking method.

   Task 3 - Groundwater Assessment twofold program. One output of this program is the update of the 1979 "Assessment of Groundwater Contamination in Michigan" (Table 3), which involves approximately 850 known and suspected contamination sites. The second output is a Demonstration Effort (Table 3) discussing the management uses of computerized geological/aquifer mapping in a one or two county area. The base maps will be similar to the computerized geological/aquifer maps listed in Table 2.

4. Mapping

   a. Computerized Geological/Aquifer Mapping of selected counties by the Geology Department of Michigan State University in cooperation with the Michigan Department of Natural Resources. This is a series of county scale computer generated maps of thickness of glacial drift, bedrock types, water table levels, and recharge potential and includes a county glacial map. (To date, Ingham, Eaton, Clinton, Allegan and Kalamazoo Counties are completed.) This program has been primarily funded through the U.S. EPA under Section 208 of the Clean Water Act (Table 2).

   b. Geological Resource Inventory Mapping, a demonstration project funded by the Geological Branch of the U.S. Geological Survey. The Michigan Geological Survey is compiling and publishing county based maps of Ingham, Kalamazoo and Allegan Counties at a 1:100,000 scale for use in interpreting geological information. Maps include information on groundwater, sand dunes, peat and coal resources, etc. Efforts are presently under way to include these maps as part of the Land Resources Division's Inventory Computer System.

5. County Aquifer Vulnerability Mapping, prepared by the Michigan Department of Public Health and Regional/County Health Departments. A series of base maps are being developed to reflect land surface and aquifer characteristics which make groundwater susceptible to contamination by certain activities (Table 3).

6. Underground Water Source Protection Program, prepared by the Geology Department at Western Michigan University (WMU), as part of the Underground Injection Control Program. The expected completion date for this EPA-funded project is early 1982. WMU is consolidating available aquifer data as well as compiling all references pertaining to groundwater in Michigan ("Hydrogeologic Atlas of Michigan" - Table 2 and "Hydrogeology for Underground Injection Control, Text" - Table 3). The project consists of:

   a. Mapping of aquifers used for drinking water.
   b. Mapping of aquifers without potential for drinking water.
   c. Inventory and assessment of certain injection wells.
   d. Compilation of mineral, water and miscellaneous well lists.
   e. Compilation of any and all wells involving the disposal of hazardous wastes.

In addition to the above major activities, there may be several minor-scale projects carried out by various state or federal agencies, or institutions.

D. ADDITIONAL GROUNDWATER RESOURCE DEFINITION NEEDS

The existing groundwater information has been reviewed and evaluated for completeness, usefulness, and accessibility. Identified inadequacies and corrective measures are listed and discussed below. The recommended corrective measures reflect the need for better data collection, access and manipulation. It is anticipated that implementation of each corrective measure would have some organizational and fiscal implications.

1. Groundwater Chemical Data - Data collected by and available through state agencies, a) are not available throughout the state, b) are scattered among the various agencies, c) have been collected at various points in time, and d) are not analytically uniform. Thus, utilization of existing data and comparisons of the quality of various groundwaters is difficult and unreliable.

   It is recommended that all groundwater chemical data collected by, or submitted to, state agencies be centralized and computerized for easy manipulation and retrieval. Present efforts by the Department of Natural Resources' Data Center to computerize the Department's laboratory data should be expanded to include, or to insure interactive access to data bases available through the Departments of Public Health and Transportation. In conjunction with such data centralization, efforts should be made to provide Department staff who use groundwater data with appropriate data processing training and access to data retrieval facilities. The Michigan Department of Public Health is currently proposing development of a data based management system for test data generated by public health laboratories.

2. Project Correspondence Files and Publications - Groundwater information found in correspondence files and various publications are also scattered among various agencies and the utilization of this existing information is also difficult.

   It is recommended that a study be conducted to determine the feasibility of data processing, retrieval, and manipulation of certain portions of that information.

3. Water Well Records (and Other Selected Groundwater Records) - Commonly used in groundwater investigations, water well records are voluminous (approximately 250,000), and continuously added to. The full informational potential of this resource cannot be achieved under the present manual method of verifying, filing, and retrieving.

   It is recommended that selected portions of water well logs be placed on computerized data banks for easy retrieval and graphic display. The computerization of the records would allow a wide range of manipulations, graphic presentations, and compilations of lists of data on geographic, chronologic, quantitative and qualitative bases. Additionally, easy and prompt retrieval of computerized

well log information would assist in early assessment of the extent of groundwater contamination incidences. It may then be feasible to incorporate other groundwater records into such a system. (These other records might include observation/monitor well records, portions of oil and gas records, etc.) Michigan's Geological Survey Division is presently involved in microfilming and establishing a computer bank for oil and gas records. A system for water well records is expected to be studied as part of this project.

4. The "National Water Data Exchange" (NAWDEX) - Coordinated by U.S. Geological Survey, this service is presently under-utilized by state agencies involved in groundwater management. The main reasons appear to be inadequate available information in a useable form on Michigan's groundwater resources, as well as lack of easy access to NAWDEX's many systems.

   It is recommended that: a) the state evaluate the information systems available through NAWDEX and identify those systems appropriate for enhancing its regulatory and resource development responsibilities, b) the state determine whether state agencies should input collected information to the selected systems on a regular basis, and c) state agency staff engaged in groundwater related programs be provided with easy access to the retrieval capabilities of the selected systems.

5. Mapping - Computerized Geological/Aquifer Mapping (Table 3), developed by Michigan State University; County Aquifer Vulnerability Mapping (Table 3), prepared by local health departments; and Exempted Aquifer Mapping (Table 2), prepared by Western Michigan University, appear to present some appropriate methods for evaluating the qualitative and quantitative character of the state's groundwaters, as well as providing powerful tools in the multifaceted management of groundwater resources. However, there is presently very little coordination among these parties in the development of the maps.

   It is recommended that attempts be made to coordinate the planning, format, and funding for the preparation of county aquifer maps, to insure: a) uniformity of scale and format, b) complete geographic coverage throughout the state, c) efficient utilization of expertise in the various facets of map development, d) continuous computerized updating capabilities and e) that available funding be used cost-effectively, as well as to facilitate the securing of additional needed funds. The Michigan Geological Survey Division (GSD) functions as the repository for the State's geological information. It is possible that GSD could then be the coordinating agency for state geologic mapping.

APPENDIX I

LOCATION OF AGENCIES, INSTITUTIONS & FIRMS
WHERE CERTAIN GROUNDWATER INFORMATION IS LOCATED
(SEE CATEGORY "AVAILABLE FROM" IN TABLES 1, 2 & 3)

FEDERAL AGENCIES:

Department of Agriculture
1405 S. Harrison, E. Lansing 48823
Soil Conservation Service (517) 337-6701

Department of Interior
6520 Mercantile Way, Lansing 48910
U.S. Geological Survey, Water Resources Div. (517) 377-1608

STATE AGENCIES:

Michigan Department of Natural Resources
Stevens T. Mason Building, Box 30028, Lansing 48909
Administrative Services Division (517) 373-9510
Environmental Services Division (517) 374-9640
Environmental Enforcement Division (517) 373-3503
Geological Survey Division (517) 373-7860 and 373-1256
Resource Recovery Division (517) 373-0907
Water Quality Division (517) 373-8147

Michigan Department of Public Health
3500 N. Logan, Box 30035, Lansing 48909
Community Environmental Health Division (517) 373-1373
Microbiology Division (517) 373-3146
Radiological Health Division (517) 373-1578
Water Supply Division (517) 373-1376

Michigan Department of Transportation
P.O. Box 30050, Lansing 48909
Testing & Research Division (517) 373-0520

COUNTY AGENCIES:

County, District Health Departments
(see page 15)

ACADEMIC INSTITUTIONS:

Michigan State University
E. Lansing 48824
Forest Service Research (517) 355-7740
Geology Dept. (517) 353-4626

Western Michigan University
Kalamazoo 49008
Geology Dept. (616) 383-6088

Michigan Technological University
Houghton, MI 49931
Geology Dept. (906) 487-2531

SERVICE & RESEARCH INSTITUTIONS:

Great Lakes Basin Commission
Box 999, Ann Arbor, MI 48106
(313) 668-2300

National Water Well Association
500 West Wilson Bridge Road
Worthington, OH 43085

West Michigan Shoreline Regional Development Commission
500 Hackley Bank Bldg., Muskegon Mall
Muskegon, MI 49440
(616) 722-7878

County, District Health Departments

Allegan County Health Dept.
Allegan County Service Bldg.
2233 Thirty-Third Street
Allegan, MI 49010

Branch-Hillsdale-St. Joseph
District Health Dept.
809 Marshall Road
Coldwater, MI 49036

Central Michigan District
Health Dept.
1222 North Drive
Mount Pleasant, MI 48858

Grand Traverse-Leelanau-Benzie
District Health Dept.
10767 Traverse Hwy.
P.O. Box 905
Traverse City, MI 49684

Jackson County Health Dept.
410 Erie Street
Jackson, MI 49202

Lenawee County Health Dept.
1301 N. Main Street
Adrian, MI 49221

Manistee-Mason District
Health Dept.
Courthouse
Manistee, MI 49600

Mid-Michigan District
Health Dept.
617 N. State Street
Stanton, MI 48888

Ottawa County Health Dept.
Ottawa County Building
414 Washington Street
Grand Haven, MI 49417

Shiawassee County Health Dept.
110 E. Mack Street
Corunna, MI 48817

Wayne County Health Dept.
Wayne County Complex
Westland, MI 48185

District Health Dept. #3
203 Antrim Street
Charlevoix, MI 49720

William Moon, M.D.
R #1
Harrietta, MI 49638

Barry-Eaton District Health Dept.
528 Beech Street
Charlotte, MI 48813

Cass County Health Dept.
Route #2
Cassopolis, MI 49031

Delta-Menominee District
Health Dept.
2920 College Avenue
Escanaba, MI 49829

Huron County Health Dept.
Huron County Bldg.
Bad Axe, MI 48413

Kalamazoo County Health Dept.
418 W. Kalamazoo Avenue
Kalamazoo, MI 49007

Livingston County Health Dept.
210 S. Highlander Way
Howell, MI 48843

Marquette County Health Dept.
184 U.S. 41 Hwy.
Negaunee, MI 49866

Monroe County Health Dept.
650 Stewart Road
Monroe, MI 48161

Saginaw County Health Dept.
1600 N. Michigan Avenue
Saginaw, MI 48602

Tuscola County Health Dept.
2266 W. Caro Road
Caro, MI 48723

Western Upper Peninsula District
Health Dept.
1100 Quincy Street
Hancock, MI 49930

District Health Dept. #4
County Office Building
719 W. Chisholm
Alpena, MI 49707

Bay County Health Dept.
Washington Park Place
301 Second Street
Bay City, MI 48706

Calhoun County Health Dept.
190 E. Michigan Avenue
Battle Creek, MI 49017

Dickinson-Iron District
Health Dept.
Commercial Bank Bldg.
130 Third Street
Stambaugh, MI 49964

Ingham County Health Dept.
403 W. Greenlawn Avenue
P.O. Box 40061
Lansing, MI 48901

Kent County Health Dept.
700 Fuller, N.E.
Grand Rapids, MI 49503

Luce-Mackinac-Alger-Schoolcraft
District Health Dept.
Community Building
Newberry, MI 49868

Mecosta County Health Dept.
400 Elm Street
County Building
Big Rapids, MI 49307

Muskegon County Health Dept.
1611 E. Oak Avenue
Muskegon, MI 49442

St. Clair County Health Dept.
3415 28th Street
Port Huron, MI 48060

VanBuren County Health Dept.
P.O. Box 307
Hartford, MI 49057

District Health Dept. #1
401 Lake Street, Room 105
Cadillac, MI 49601

District Health Dept. #5
Courthouse
White Cloud, MI 49349

Berrien County Health Dept.
769 Pipestone
P.O. Box 706
Benton Harbor, MI 49022

Chippewa County Health Dept.
139 Arlington Street
Sault Ste. Marie, MI 49783

Genesee County Health Dept.
310 W. Oakley Street
Flint, MI 48503

Ionia County Health Dept.
Perrone Bldg.
111 N. Kidd Street
Ionia, MI 48846

Lapeer County Health Dept.
1575 Suncrest Drive
Lapeer, MI 48446

Macomb County Health Dept.
Macomb County Health Center
43525 Elizabeth Road
Mount Clemens, MI 48043

Midland County Health Dept.
125 W. Main Street
Midland, MI 48640

Oakland County Health Dept.
1200 N. Telegraph Road
Pontiac, MI 49053

Sanilac County Health Dept.
115 N. Elk Street
Sandusky, MI 48471

Washtenaw County Health Dept.
2355 W. Stadium Blvd.
P.O. Box 8645
Ann Arbor, MI 48107

District Health Dept. #2
806 W. Houghton Street
P.O. Box 38
West Branch, MI 48661

Detroit City Health Dept.
Herman Kiefer Health Complex
1151 Taylor
Detroit, MI 48202

APPENDIX II

COMPUTER PROGRAMS & COMPUTER INFORMATION SOURCES
(See TABLE 3)

Because the following information was submitted to the Michigan Department of Natural Resources in response to a questionnaire and because the field of groundwater computer analyses is rapidly expanding, this information may represent only a portion of the computer programs and computer information sources used by agencies, universities and firms performing groundwater services in Michigan.

GROUNDWATER FLOW MODELS
- Layne Northern, Inc. - Lansing, MI 48901
- Associated Water and Air Resources Engineers (Aware, Inc.) - Nashville, TN 37204
- Snell Environmental Group - Lansing, MI 48906
- MDNR Water Management Division
- U.S. Geological Survey
- L.M. MIller and Associates - Ann Arbor, MI 48104
- Keck Consulting Services, Inc. - Williamston, MI 48895

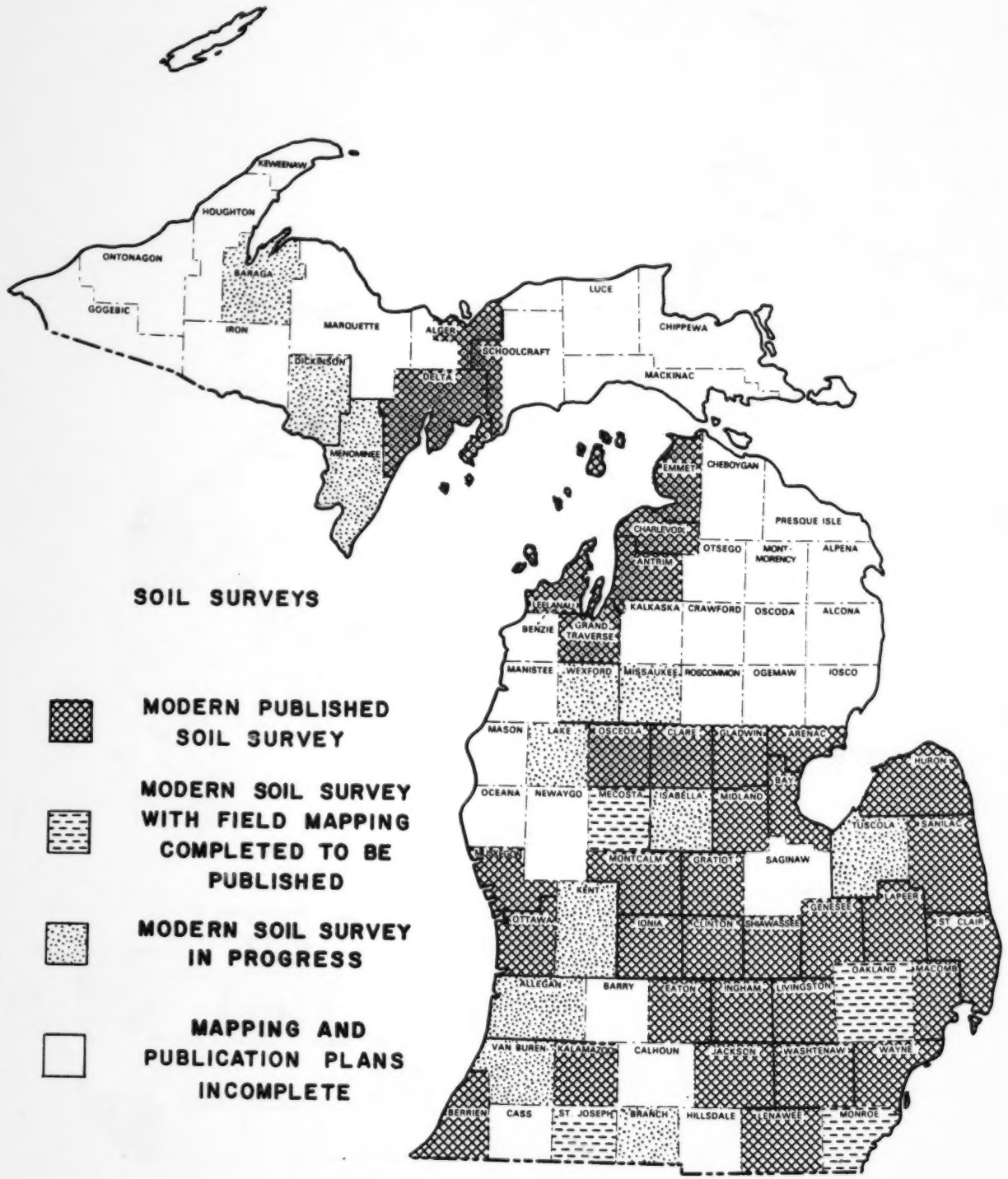
MASS TRANSPORT MODELS
- Commonwealth Associates - Jackson, MI 49201
- MDNR Water Management Division
- U.S. Geological Survey
- Dames and Moore, Inc. - Park Ridge, IL 60068
- Associated Water and Air Resources Engineers (Aware, Inc.)

WATER BUDGET MODELS
- Keck Consulting Services, Inc.
- Ingham County Drain Commission - Mason, MI 48854

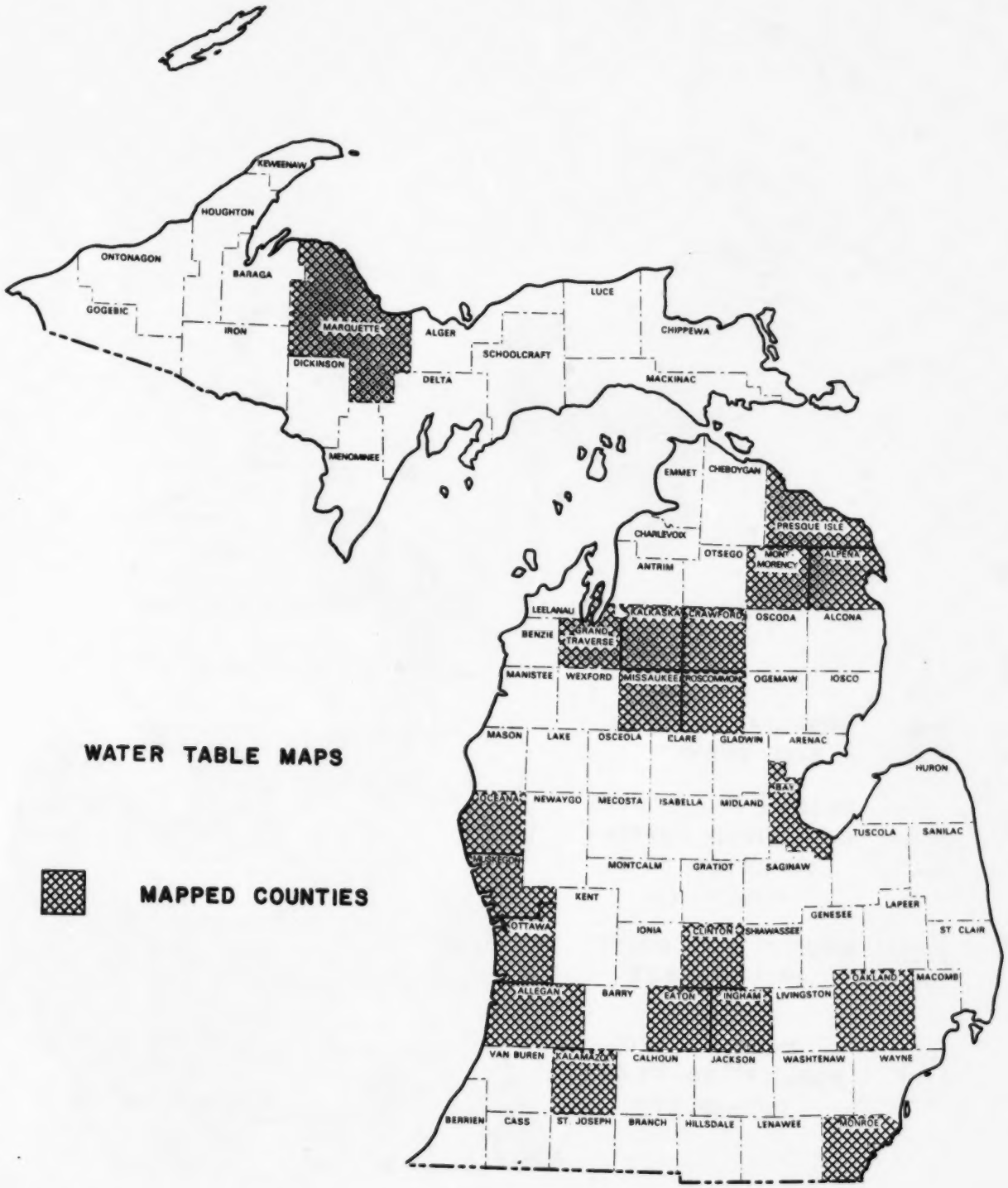
MAPPING PROGRAMS
- Resource Information Associates - Charlotte, MI 48813
- Michigan Technological University (SYMAP)
- Michgian State University (SYMAP)

SPECIFIC APPLICATIONS
- Geophysical Exploration Models - Keck Consulting Services, Inc.
- Electrical Resistivity - L.M. Miller and Associates
- Liquid Waste Disposal in Deep Saline Aquifers - Snell Environmental Group
- Mounding Models - Keck Consulting Services, Inc.
- Piezometric Model for Lansing Metropolitan Area - Lansing Board of Water and Light - Lansing, MI 48933
- Well Field Simulation - Keck Consulting Services, Inc.

APPENDIX III



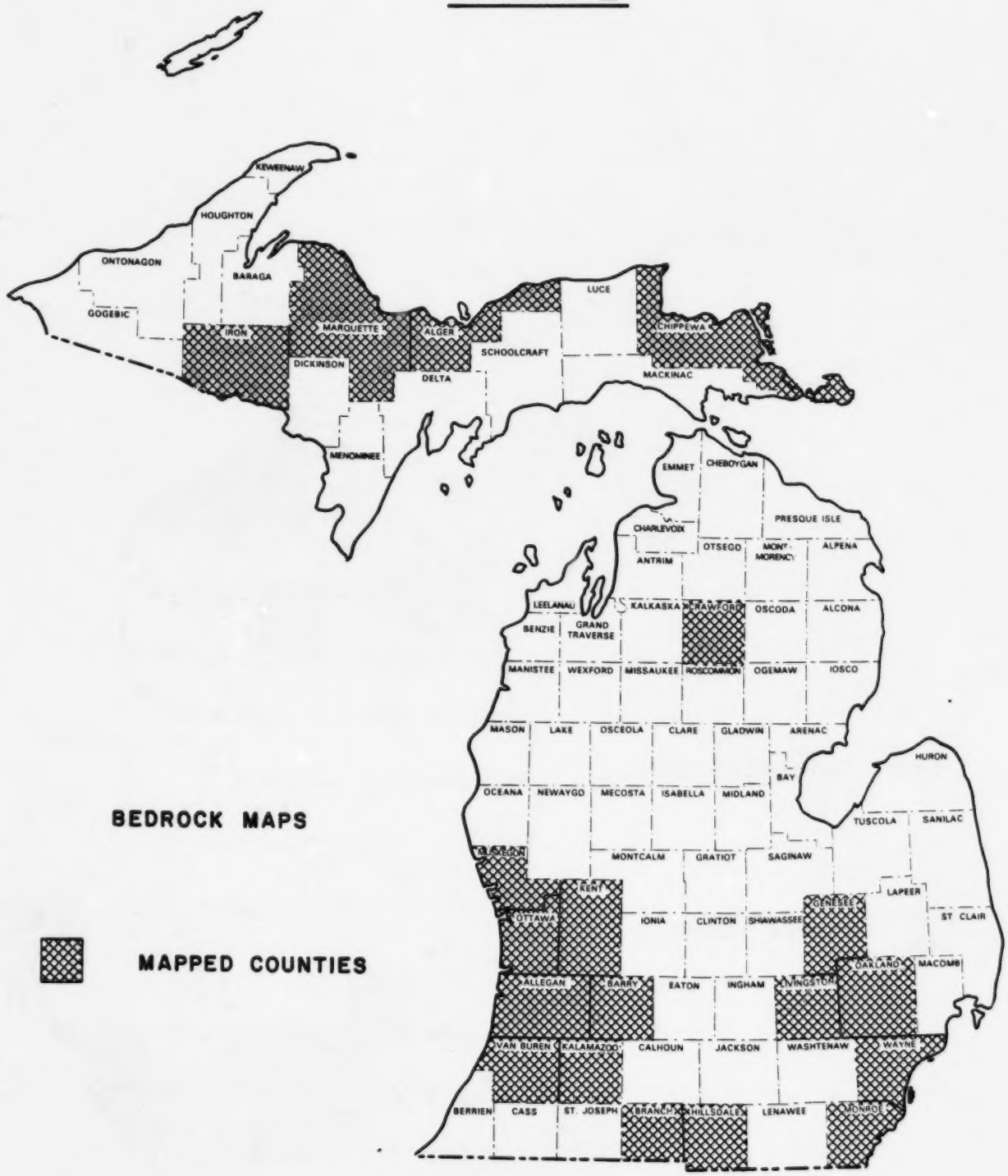
APPENDIX IV



WATER TABLE MAPS

MAPPED COUNTIES

APPENDIX V

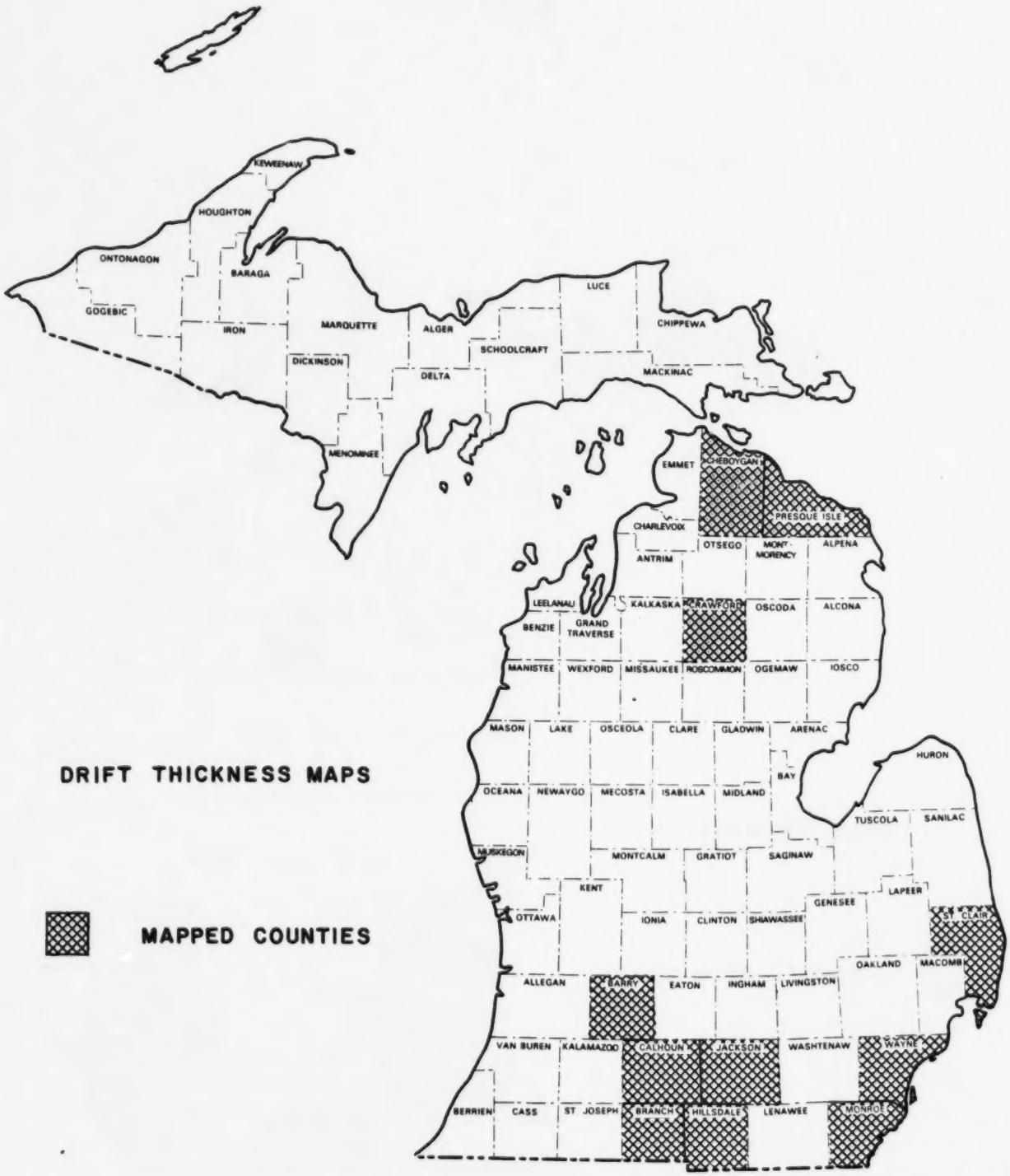


BEDROCK MAPS

MAPPED COUNTIES

11/81

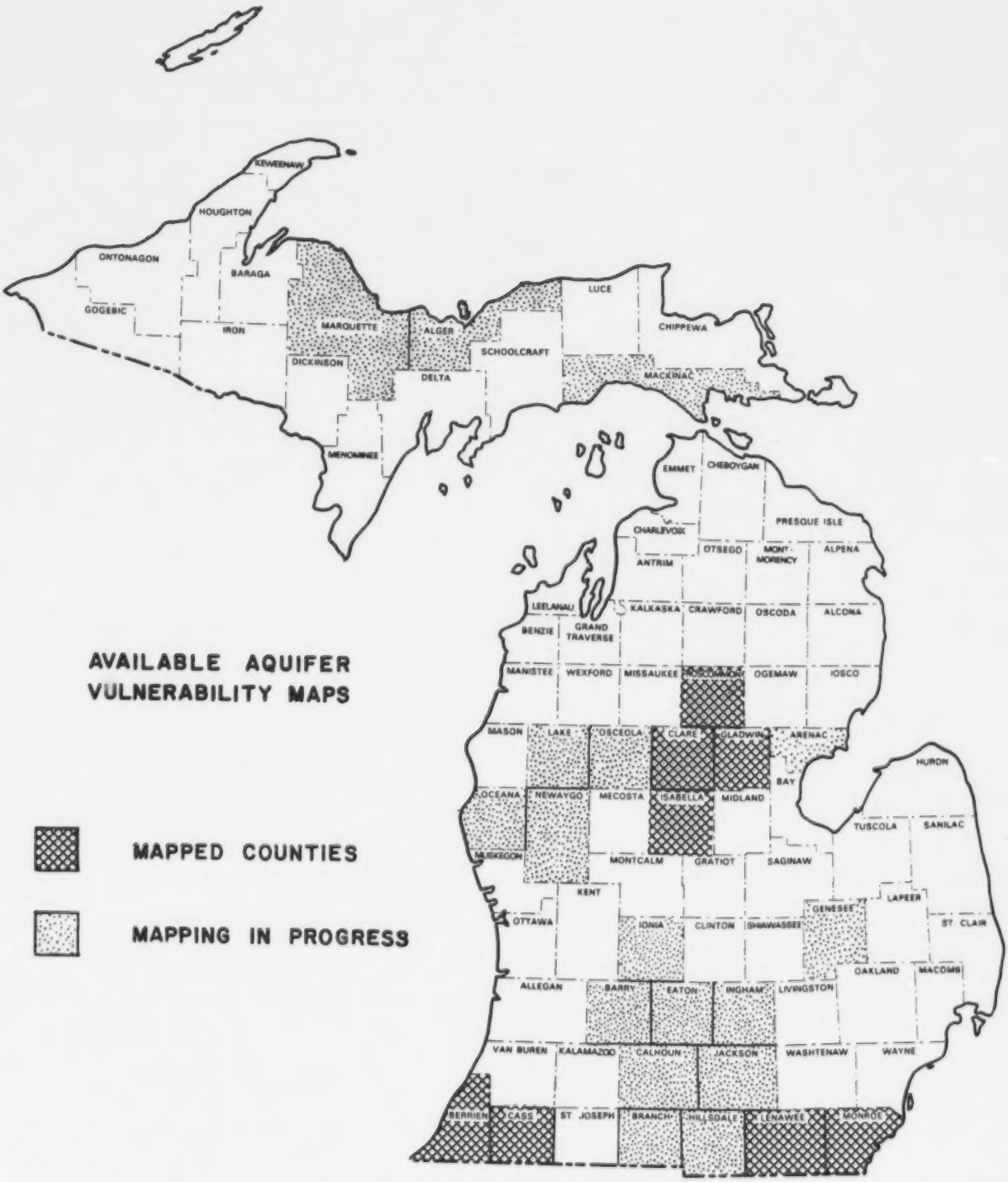
APPENDIX VI



DRIFT THICKNESS MAPS

MAPPED COUNTIES

APPENDIX VII



AVAILABLE AQUIFER VULNERABILITY MAPS

MAPPED COUNTIES

MAPPING IN PROGRESS